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Monthly Performance Report

CHARLOTTE MEDICAL CENTER

APRIL 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT
CHARLOTTE MEDICAL CENTER
APRIL 1979

I. SYSTEM DESCRIPTION

The Charlotte Medical Center, Charlotte, North Carolina, solar energy system was designed to provide both space heating and domestic hot water for a six-story medical library, office and classroom building. Solar energy collection is accomplished by an array of General Electric flat-plate collectors using a 50 percent (by volume) aqueous solution of ethylene glycol. The collector array has a gross area of 4,020 square feet and faces south at an angle of 35 degrees from the horizontal. Storage capacity is 6,000 gallons of water in an underground tank. In addition to the primary storage tank, there are three domestic hot water (DHW) tanks, each of which has a capacity of 125 gallons. Auxiliary heating for both subsystems is provided by electrical resistance heaters. Each DHW tank contains a 12 kw electrical immersion heater. The space heating subsystem has a capacity of 261 kw, of which 11 kw is contained in supplementary baseboard heaters on the first floor of the building.

The system, shown schematically in Figure 1, has six basic modes of operation.

Mode 1 - Collector-to-Space Heating: This mode is entered whenever there is a demand for space heating and the solar panel temperature is above 100°F. Pump P1 is started when the solar panel temperature first rises above 100°F, and will continue to run while either the solar panel temperature is above 85°F, or the water thermal storage temperature is above 85°F and the air-handling unit (AHU) is calling for heat. In this mode, pump P1 circulates the solar heated ethylene glycol solution from the collectors, through valve V2, heat exchanger HX2, valve V1, valve V4 and back to the collectors. Thus, the solar heated solution flows from the collectors directly to the space heating exchanger HX2; storage loop heat exchanger HX4 is bypassed.

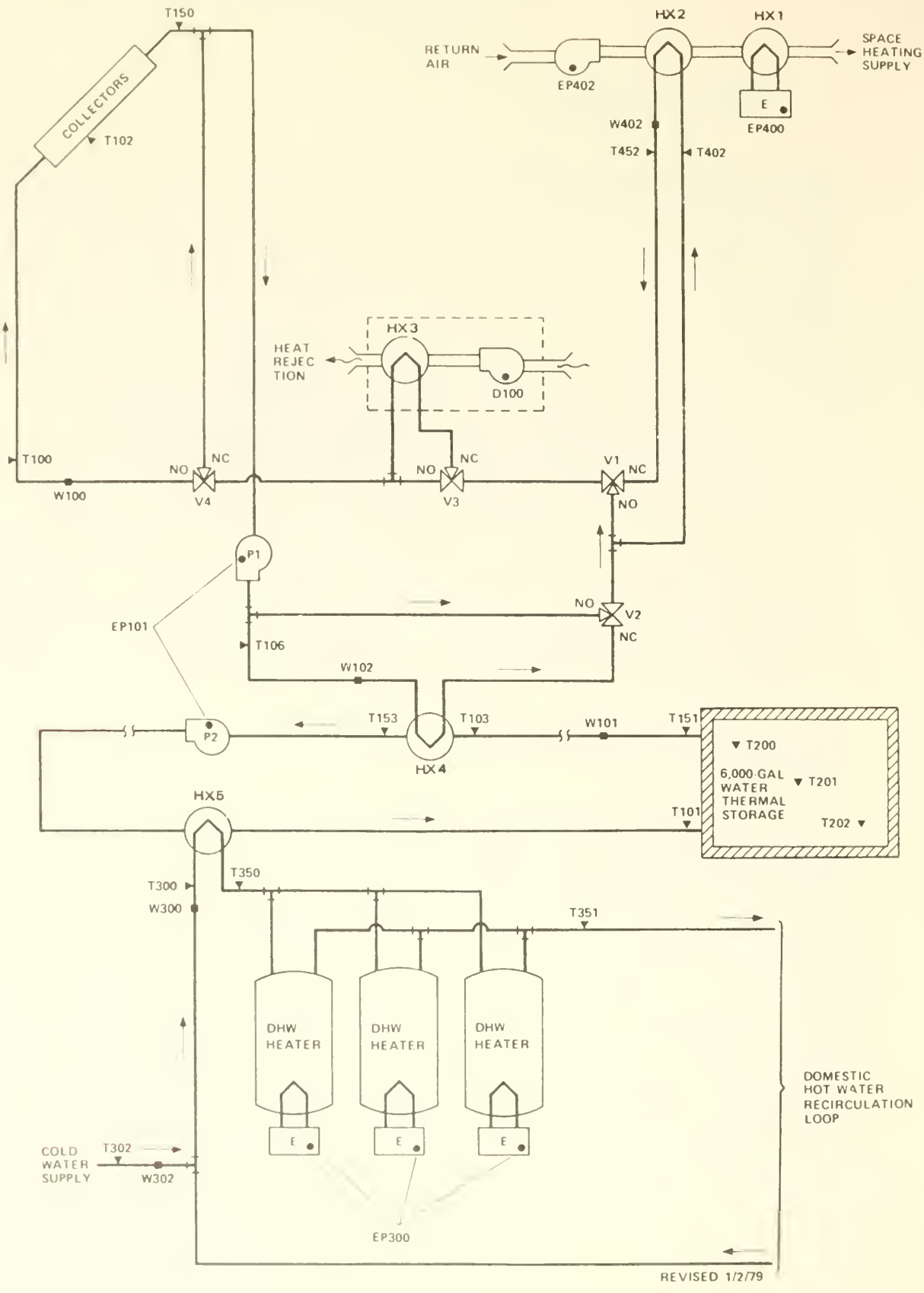

Figure 1. CHARLOTTE MEDICAL CENTER SOLAR ENERGY SYSTEM SCHEMATIC

Mode 2 - Collector-to-Space Heating and Storage: With the water thermal storage temperature below 85°F and the AHU calling for maximum heat, AHU heating valve V1 is fully open to the AHU heating coil HX2 and valve V2 is in the normally open position. As the heating demand becomes satisfied, valve V1 is modulated toward the by-pass position and valve V2 is modulated open to the storage heat exchanger HX4. When valve V2 begins to open to heat exchanger HX4, pump P2 is started, charging the 6,000-gallon water thermal storage. After the storage temperature increases above 85°F, pump P2 runs continuously to provide DHW preheat through heat exchanger HX5.

Mode 3 - Collector-to-Storage: This mode is entered when the system is running, there is no demand for space heating, and the solar panel temperature is greater than the storage temperature. During this mode, valve V2 is open to heat exchanger HX4 so that collected solar energy is delivered to storage. However, in the event that the storage temperature is greater than the solar panel temperature, valve V2 returns to the full by-pass position.

Mode 4 - Storage-to-Space Heating: This mode is entered whenever the solar panel temperature is below 85°F, the storage temperature is greater than 85°F, and there is a demand for space heating. Since the storage temperature is above 85°F, pump P2 is operating. When the AHU controls call for heating, pump P1 is started. If the solar panel temperature is below 85°F, valve V2 is positioned full open to heat exchanger HX4, and valve V4 is positioned to by-pass the solar panels. Hot water from storage is now pumped through heat exchanger HX4. Pump P1 circulates the transport fluid through the load side of heat exchanger HX4 and the AHU heating coil HX2 as determined by modulating valve V1.

Mode 5 - Excess Solar Heat Rejection: This mode is entered if the solar loop temperature increases above 200°F. Valve V2 goes to the full by-pass position and valve V3 opens to allow excess solar heat to be rejected to the atmosphere through heat exchanger HX3. Pump P2 continues to operate to preheat service hot water and valve V2 modulates to maintain a maximum temperature of 200°F in the water thermal storage.

Mode 6 - Domestic Water Preheat: This mode is entered whenever storage temperature is greater than 85°F. Pump P2 circulates water from storage through hot water heat exchanger HX5.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The operation of the Charlotte Medical Center solar energy system during April was limited to a considerable extent by improper control system behavior. There were several days during the month when the insolation level was high enough to permit solar energy collection but collector array flow was either sporadic or non-existent. This is the opposite of the situation that occurred during March when collector array flow often continued into the late evening hours. These control problems have been discussed in detail in prior reports and the site contractor is addressing the problem. Although experiencing control problems, the system realized a net hot water and space heating electrical energy savings of 15.73 million Btu for the month. A total of 3.88 million Btu of electrical operating energy was required to support the system during April.

A site data acquisition subsystem problem caused data to be lost from April 1 through April 4. A site visit was made on April 4 to correct the problem.

B. Weather

During April, the measured average outside ambient temperature was 62°F. This was two degrees above the long-term average ambient temperature of 60°F and reduced the building heating load. Long-term temperature data are taken directly from data supplied by the National Oceanic and Atmospheric Administration's Local Climatological Data Bulletin for Charlotte.

The measured value for insolation incident in the plane of the collector array was 1,608 Btu/ft^2-day, and this was below the long-term average of 1,704 Btu/ft^2-day. However, the measured value of insolation is in error due to a pyranometer shading problem. The pyranometer is shaded at times during the day by the instrument that monitors wind velocity and direction, so the actual value for measured insolation is apparently higher than that reported. Long-term insolation in the plane of the collector array is derived from data for Charlotte taken from the SOLMET Volume 1 - User's Manual.

C. System Thermal Performance

Collector - During April, the Charlotte solar energy system collected a net amount of 28.84 million Btu. However, approximately 0.24 million Btu were lost by the collector array due to the erratic operation caused by the control system. Also, an additional 0.32 million Btu were deliberately rejected by the heat rejection fan, and this situation was also a direct result of the sporadic collector array operation. On bright days the fluid in the collector loop would exceed temperatures of 200°F during stagnation periods and this caused the heat rejection fan to come on for short periods of time.

A total of 193.91 million Btu of incident solar energy was measured in the plane of the collector array during April. However, as previously noted,

a net amount of only 28.84 million Btu was collected. This was due to the limited amount of array operating time. As a result, the reported collector array efficiency was only 15 percent. The sporadic operation of the collector array also negates any discussion relating to operational collector array efficiency because the limited periods of operation generally occurred during the time of peak insolation. As a result, the operational efficiency term would be artificially inflated.

The solar energy collected by the array was utilized as follows: 15.14 million Btu were delivered to storage, and the remainder went to the space heating subsystem or was lost in the form of transport losses to the building interior.

One final point should be noted concerning the collector array. During a site visit in January, it was observed that the collector glazings had yellowed to some degree. A sample piece of the glazing from a scrap collector was analyzed at the Marshall Space Flight Center and it was found that this yellowing had caused a decrease in transmissivity of approximately seven percent. If this degradation continues, there will be a significant reduction in system performance.

Storage During April, a total of 16.01 million Btu was delivered to water thermal storage. Of this total, 15.14 million Btu came from the collector array, and 0.87 million Btu came from the hot water recirculation loop. The energy from the hot water recirculation loop can be traced back to the electrical auxiliary heaters in the DHW heater tanks. This is a system design problem which was discussed in detail in the November 1978 report.

A total of 8.49 million Btu was removed from storage during the month. However, approximately 0.24 million Btu of this energy was rejected to the atmosphere because of the control problems.

The change in stored energy was 2.70 million Btu, and this, plus the energy supplied to and removed from storage, resulted in a thermal loss from storage of 4.82 million Btu. Storage was maintained at an average temperature of 103°F, and the monthly storage efficiency was 0.70.

Hot Water Load - The hot water load for April was 1.60 million Btu. This is based on an average supply water temperature of 70°F, an average service hot water temperature of 117°F and an average daily consumption of 120 gallons of hot water. Solar energy supplied to the hot water subsystem amounted to 2.32 million Btu. However, because of a design problem with the recirculation loop in the hot water subsystem, a total of 0.87 million Btu of electrical auxiliary energy was delivered from the service hot water tanks to the solar energy storage loop. This resulted in a net energy delivery to the hot water subsystem of 1.45 million Btu. This design problem was discussed in detail in the November 1978 report.

The indicated hot water solar fraction of 23 percent is based only on periods when solar energy was being delivered to the hot water subsystem. During periods when auxiliary energy was being delivered to the solar energy storage loop, the hot water solar fraction was considered to be zero.

Approximately 5.91 million Btu of auxiliary electrical energy were delivered to the hot water subsystem. Therefore, a total of 8.23 million Btu was actually used to support the hot water subsystem. Since the actual hot water load was 1.60 million Btu, and 0.87 million Btu were delivered back to the solar energy storage loop, the total losses for the hot water tanks and recirculation loop piping amounted to 5.76 million Btu for April.

Space Heating Load - The space heating load for April was 44.81 million Btu. Solar energy supplied 18.16 million Btu of this load, which resulted in a heating solar fraction of 41 percent. The remaining 26.51 million Btu of energy required to support the space heating subsystem were supplied by the supplemental baseboard electrical auxiliary system on the first floor of the building. The slight discrepancy between the

sum of the solar and auxiliary energies supplied to the space heating subsystem and the space heating load is due to the fact that control anomalies allowed approximately C.15 million Btu to be removed from the building interior and rejected to the atmosphere. The main electrical auxiliary system was turned off in early April and showed no energy consumption during the final 26 days of the month.

The total energy delivered to the building maintained an average interior temperature of 72°F. The average outside ambient temperature was 62°F.

D. Observations

The April operation of the Charlotte Medical Center solar energy system was somewhat contrary to the system design. The abnormal operation, in conjunction with the control system and hot water subsystem design problems, degraded system performance to a considerable extent.

E. Energy Savings

During the month of April, the Charlotte solar energy system realized a net electrical energy savings of 15.73 million Btu. The space heating subsystem and hot water subsystem operation saved a total of 19.61 million Btu, but this was reduced by the 3.88 million Btu of electrical energy required to operate the system.

III. ACTION STATUS

The system problems were previously brought to the attention of the system designer and the situation is under detailed investigation. A modification to the system control logic is being developed at the present time.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/04
REPORT PERIOD: APRIL,1979

SITE/SYSTEM DESCRIPTION:THE CHARLOTTE SOLAR SYSTEM PROVIDES HEATING AND HOT WATER FOR THE AREA HEALTH AND EDUCATION FACILITY. THIS FACILITY HAS 65,000 SQ. FT. CONTAINED IN SIX STORIES AND USES ELECTRICITY FOR AUXILLARY HEATING.THE DHW SYSTEM HAS THREE(3) 12 KW HEATERS AND THE SPACE HEATING SYSTEM HAS A 250 KW STRIP HEATER ALONG WITH 11.1 KW OF SUPPLEMENTAL BASEBOARD HEAT ON THE FIRST FLOOR.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	193.911	MILLION BTU
	48236	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	28.839	MILLION BTU
	7174	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	62	DEGREES F
AVERAGE BUILDING TEMPERATURE	72	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.10	
ECSS OPERATING ENERGY	3.880	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	5.798	MILLION BTU
TOTAL ENERGY CONSUMED	67.055	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.603	44.813	N.A.	46.416 MILLION BTU
SOLAR FRACTION	23	41	N.A.	40 PERCENT
SOLAR ENERGY USED	1.454	18.156	N.A.	19.609 MILLION BTU
OPERATING ENERGY	N.A.	1.918	N.A.	5.798 MILLION BTU
AUX. THERMAL ENERGY	5.911	26.508	N.A.	32.418 MILLION BTU
AUX. ELECTRIC FUEL	5.911	26.508	N.A.	32.418 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	1.454	18.156	N.A.	15.729 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.365

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/04
REPORT PERIOD: APRIL,1979

SITE/SYSTEM DESCRIPTION:THE CHARLOTTE SOLAR SYSTEM PROVIDES HEATING AND HOT WATER FOR THE AREA HEALTH AND EDUCATION FACILITY. THIS FACILITY HAS 65,000 SQ. FT. CONTAINIED IN SIX STORIES AND USES ELECTRICITY FOR AUXILLARY HEATING.THE DHW SYSTEM HAS THREE(3) 12 KW HEATERS AND THE SPACE HEATING SYSTEM HAS A 250 KW STRIP HEATER ALONG WITH 11.1 KW OF SUPPLEMENTAL BASEBOARD HEAT ON THE FIRST FLOOR.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	204.576	GIGA JOULES
	547773	KJ/SQ.M.
COLLECTED SOLAR ENERGY	30.425	GIGA JOULES
	81467	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	17	DEGREES C
AVERAGE BUILDING TEMPERATURE	22	DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.10	
ECSS OPERATING ENERGY	4.094	GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	6.117	GIGA JOULES
TOTAL ENERGY CONSUMED	70.743	GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.692	47.277	N.A.	48.969 GIGA JOULES
SOLAR FRACTION	23	41	N.A.	40 PERCENT
SOLAR ENERGY USED	1.534	19.154	N.A.	20.688 GIGA JOULES
OPERATING ENERGY	N.A.	2.023	N.A.	6.117 GIGA JOULES
AUX. THERMAL ENG	6.236	27.966	N.A.	34.201 GIGA JOULES
AUX. ELECTRIC FUEL	6.236	27.966	N.A.	34.201 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	1.534	19.154	N.A.	16.594 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.365

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978. SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	*	*	*	N	*	*	*
2	*	*	*	O	*	*	*
3	*	*	*	T	*	*	*
4	*	*	*		*	*	*
5	8.539	60	2.074	A	0.137	0.000	0.243
6	8.941	58	2.046	P	0.123	0.000	0.229
7	8.866	59	2.344	P	0.151	0.000	0.264
8	4.704	60	1.251	L	0.113	0.000	0.266
9	7.392	59	1.511	I	0.095	0.000	0.204
10	8.798	54	2.430	C	0.135	0.000	0.276
11	2.550	60	0.615	A	0.083	0.000	0.241
12	2.982	67	0.107	B	0.058	0.000	0.036
13	0.414	62	0.016	L	0.000	0.000	0.040
14	8.195	60	0.107	E	0.091	0.000	0.013
15	8.348	62	-0.021		0.100	0.000	-0.002
16	9.039	60	0.107		0.101	0.000	0.012
17	8.836	58	0.020		0.120	0.000	0.002
18	8.897	61	1.452		0.132	0.238	0.163
19	8.562	62	0.477		0.111	0.282	0.056
20	8.619	64	0.500		0.139	-0.257	0.058
21	7.378	68	0.108		0.189	0.000	0.015
22	7.201	70	0.221		0.187	0.012	0.031
23	4.150	69	0.234		0.168	0.000	0.056
24	5.264	69	0.371		0.180	0.000	0.070
25	1.882	62	0.106		0.144	0.000	0.057
26	2.885	64	0.028		0.138	0.000	0.010
27	5.351	68	0.100		0.173	0.000	0.019
28	5.338	60	0.171		0.141	0.000	0.032
29	6.773	56	0.342		0.176	0.000	0.050
30	8.153	62	0.277		0.180	0.000	0.034
SUM	193.911	-	19.609	N.A.	3.880	0.317	-
AVG	6.464	62	0.654	N.A.	0.129	0.011	0.101
NBS ID	C001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	*	*	*	*	*
2	*	*	*	*	*
3	*	*	*	*	*
4	*	*	*	*	*
5	8.539	7.360	3.518	66	0.412
6	8.941	4.049	2.463	70	0.275
7	8.866	5.563	2.619	67	0.295
8	4.704	2.910	1.557	*	0.331
9	7.392	3.701	1.759	70	0.238
10	8.798	6.974	3.263	62	0.371
11	2.550	0.045	0.146	67	0.057
12	2.982	0.114	-0.009	73	-0.003
13	0.414	0.000	0.000	62	0.000
14	8.195	0.078	-0.040	69	-0.005
15	8.348	0.094	0.013	72	0.002
16	9.039	0.086	0.063	68	0.007
17	8.836	1.261	0.955	65	0.108
18	8.897	2.050	1.994	69	0.224
19	8.562	0.784	1.281	73	0.150
20	8.619	2.472	1.340	75	0.155
21	7.378	2.186	1.109	80	0.150
22	7.201	0.534	0.281	78	0.039
23	4.150	0.000	0.000	77	0.000
24	5.264	0.376	0.083	76	0.016
25	1.882	0.000	0.000	67	0.000
26	2.885	0.121	0.270	70	0.094
27	5.351	0.800	0.428	*	0.080
28	5.338	0.913	0.774	*	0.145
29	6.773	0.464	0.438	63	0.065
30	8.153	1.117	0.689	73	0.085
SUM	193.911	50.830	28.839	-	-
AVG	6.464	1.694	0.961	70	0.149
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COCLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	*	*	*	*	*
2	*	*	*	*	*
3	*	*	*	*	*
4	*	*	*	*	*
5	1.604	0.518	1.050	92	0.978
6	0.663	0.577	-0.215	100	0.546
7	1.103	0.926	-0.115	99	0.735
8	0.470	0.559	-0.185	93	0.796
9	0.842	0.297	0.320	94	0.732
10	1.216	0.737	0.299	102	0.852
11	0.008	0.597	-0.764	94	-21.837
12	0.000	0.000	-0.030	87	1.000
13	0.000	0.000	-0.020	86	1.000
14	0.000	0.000	-0.030	85	1.000
15	0.000	0.000	-0.040	85	1.000
16	0.000	0.000	-0.040	84	1.000
17	0.730	0.016	0.775	89	1.083
18	0.367	0.299	-0.105	99	0.529
19	0.264	0.223	-0.255	95	-0.120
20	1.025	0.025	0.848	100	0.851
21	1.252	0.159	0.918	121	0.861
22	0.551	0.219	0.040	129	0.469
23	0.066	0.235	-0.491	124	-3.876
24	0.366	0.187	-0.065	118	0.335
25	0.105	0.184	-0.278	115	-0.895
26	0.180	0.174	-0.159	110	0.081
27	0.802	0.115	0.318	112	0.540
28	0.803	0.225	0.422	120	0.806
29	0.343	0.793	-0.531	117	0.763
30	1.119	0.292	0.675	121	0.864
SUM	16.014	8.489	2.703	-	-
AVG	0.534	0.283	0.090	103	0.699
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: CHARLOTTE MEM. HOSP. & MED. CENT.
REPORT PERIOD: APRIL.1979

SOLAR/2010-79/04

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	*	*	*	N	*	*	N	*	N	*	*	*
2	*	*	*	O	*	*	O	*	O	*	*	*
3	*	*	*	T	*	*	T	*	T	*	*	*
4	*	*	*	A	*	*	A	*	A	*	*	*
5	0.113	7	-0.031	P	0.329	0.329	P	-0.031	P	64	116	242
6	0.085	1	-0.027	P	0.300	0.300	P	-0.027	P	64	116	183
7	0.009	1	-0.067	L	0.268	0.268	L	-0.067	L	68	116	21
8	0.002	1	-0.083	I	0.292	0.292	I	-0.083	I	73	116	4
9	0.087	1	-0.033	C	0.299	0.299	C	-0.033	C	63	116	188
10	0.083	8	0.005	A	0.266	0.266	A	0.005	A	63	116	179
11	0.102	2	-0.076	B	0.351	0.351	B	-0.076	B	64	116	225
12	0.073	6	0.016	L	0.246	0.246	L	0.016	L	65	116	159
13	0.070	6	0.016	E	0.245	0.245	E	0.016	E	66	116	153
14	0.001	8	0.017		0.173	0.173		0.017		76	116	4
15	0.001	9	0.019		0.174	0.174		0.019		77	116	3
16	0.004	9	0.019		0.186	0.186		0.019		74	116	11
17	0.072	3	-0.049		0.287	0.287		-0.049		67	116	161
18	0.082	2	-0.085		0.354	0.354		-0.085		66	116	185
19	0.058	1	-0.023		0.257	0.257		-0.023		67	116	131
20	0.091	8	0.038		0.244	0.244		0.038		67	116	209
21	0.003	23	0.148		0.105	0.105		0.148		78	121	8
22	0.004	90	0.231		0.000	0.000		0.231		79	125	10
23	0.076	98	0.240		0.000	0.000		0.240		68	120	169
24	0.077	89	0.219		0.030	0.030		0.219		69	115	183
25	0.059	72	0.118		0.118	0.118		0.118		68	116	140
26	0.065	27	0.028		0.209	0.209		0.028		69	116	155
27	0.086	20	0.100		0.177	0.177		0.100		68	116	204
28	0.004	36	0.161		0.060	0.060		0.161		77	119	11
29	0.002	62	0.121		0.064	0.064		0.121		78	117	5
30	0.082	59	0.236		0.089	0.089		0.236		69	119	178
SUM	1.603	-	1.454	N.A.	5.911	5.911	N.A.	1.454	N.A.	-	-	3600
AVG	0.053	23	0.048	N.A.	0.197	0.197	N.A.	0.048	N.A.	70	117	120
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: CHARLOTTE MEM. HOSP. & MED. CENT. SOLAR/2010-79/04
REPORT PERIOD: APRIL,1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	*	*	*	*	*	*	N	*	N	*	*
2	*	*	*	*	*	*	O	*	O	*	*
3	*	*	*	*	*	*	T	*	T	*	*
4	*	*	*	*	*	*		*		*	*
5	2.768	76	2.105	0.205	0.663	0.663	A	2.105	A	76	60
6	2.742	76	2.073	0.180	0.669	0.669	P	2.073	P	76	58
7	3.097	78	2.411	0.213	0.687	0.687	P	2.411	P	75	59
8	2.004	67	1.334	0.163	0.669	0.669	L	1.334	L	75	60
9	2.207	70	1.544	0.133	0.663	0.663	I	1.544	I	76	59
10	3.263	74	2.426	0.195	0.837	0.837	C	2.426	C	75	54
11	1.615	43	0.690	0.116	0.925	0.925	A	0.690	A	73	60
12	1.097	8	0.090	0.013	1.006	1.006	B	0.090	B	72	67
13	1.038	0	0.000	0.000	1.038	1.038	L	0.000	L	70	62
14	0.989	9	0.089	0.012	0.900	0.900	E	0.089	E	71	60
15	0.831	0	-0.040	0.028	0.831	0.831		-0.040		71	62
16	0.989	11	0.088	0.053	0.879	0.879		0.088		71	60
17	0.980	7	0.069	0.003	0.911	0.911		0.069		71	58
18	2.426	63	1.537	0.134	0.889	0.889		1.537		73	61
19	1.426	35	0.501	0.080	0.925	0.925		0.501		73	62
20	1.315	35	0.462	0.051	0.853	0.853		0.462		73	64
21	0.905	0	-0.039	0.029	0.905	0.905		-0.039		71	68
22	0.936	0	-0.010	0.008	0.936	0.936		-0.010		71	70
23	0.878	0	-0.006	0.003	0.878	0.878		-0.006		71	69
24	0.993	15	0.151	0.001	0.841	0.841		0.151		72	69
25	0.947	0	-0.012	0.011	0.947	0.947		-0.012		71	62
26	0.969	0	0.000	0.000	0.969	0.969		0.000		71	64
27	0.931	0	0.000	0.000	0.931	0.931		0.000		71	68
28	1.129	1	0.009	0.002	1.120	1.120		0.009		70	60
29	1.380	16	0.221	0.023	1.159	1.159		0.221		68	56
30	0.983	4	0.041	0.003	0.943	0.943		0.041		70	62
SUM	44.813	-	18.156	1.918	26.508	26.508	N.A.	18.156	N.A.	-	-
AVG	1.494	41	0.605	0.064	0.884	0.884	N.A.	0.605	N.A.	72	62
NBS	Q402	N400	Q400	Q403	C401		Q410	Q415	Q417	N406	N113

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: CHARLOTTE MEM. HOSP. & MED. CENT.
REPORT PERIOD: APRIL,1979

SOLAR/2010-79/04

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	*	N	*	*	N	*	*
2	*	O	*	*	O	*	*
3	*	T	*	*	T	*	*
4	*		*	*		*	*
5	2124	A	60	66	A	300	2
6	2224	P	58	70	P	280	6
7	2206	P	59	67	P	0	2
8	1170	L	60	*	L	205	6
9	1839	I	59	70	I	240	8
10	2188	C	54	62	C	0	2
11	634	A	60	67	A	0	2
12	742	B	67	73	B	101	2
13	103	L	62	62	L	*	3
14	2039	E	60	69	E	359	3
15	2077		62	72		293	4
16	2249		60	68		318	4
17	2198		58	65		0	2
18	2213		61	69		13	2
19	2130		62	73		14	2
20	2144		64	75		44	3
21	1835		68	80		186	2
22	1791		70	78		199	4
23	1032		69	77		188	2
24	1309		69	76		145	3
25	468		62	67		93	4
26	718		64	70		123	4
27	1331		68	*		0	2
28	1328		60	*		9	3
29	1685		56	63		0	2
30	2028		62	73		0	1
SUM	48236	N.A.	-	-	-	-	-
AVG	1608	N.A.	62	70	N.A.	*	3
NBS ID	0001		N113			N115	N114

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